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Solution 1 :

Air pollution refers to the release of pollutants into the air—pollutants which are detrimental to human health and the planet as a whole. According to the World Health Organization (WHO), each year air pollution is responsible for nearly seven million deaths around the globe. Nine out of ten human beings currently breathe air that exceeds the WHO's guideline limits for pollutants, with those living in low- and middle-income countries suffering the most. In the United States, the Clean Air Act, established in 1970, authorizes the U.S. Environmental Protection Agency (EPA) to safeguard public health by regulating the emissions of these harmful air pollutants.

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The atmospheric air contains about 79 percent of nitrogen and 21 percent of oxygen and the negligible traces of other sixteen elements such as carbon monoxide, carbon dioxide, ammonia, sulphur, methane etc are found which have practically no adverse effect. This air is considered as pure as healthy and is always desireable for human life, animal life and plant life. But due to various factors athe balance of nitrogen and oxygen diturbed gradually and is causing adverse effect on human health, animal life, plant life and other materials of the universe.

So, the accumulation of destructive elements in the air from the natural or unnatural sources is termed as air pollution.

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"We've made progress over the last 50 years improving air quality in the United States thanks to the Clean Air Act," says Kim Knowlton, senior scientist and deputy director of the NRDC Science Center. "But climate change will make it harder in the future to meet pollution standards, which are designed to protect health."

So the accumulation of destructive elements in the air from the natural and unnatural sources is called Air Pollution

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Top Causes for air pollution :

1. The Burning Of Fossil Fuels

Most of the air pollution takes place due to the burning of fossil fuels such as coal, oil, gasoline to produce energy for electricity or transportation. The release of carbon monoxide in high level indicates how much fossil fuel is burned. This also emits other toxic pollutants in the air. Inhaling air induced with pollutants due to the burning of natural gas and fossil fuel reduces heart's ability to pump enough oxygen causing one to suffer respiratory illness.

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2. Industrial Emission

Industrial activities emit several pollutants in the air that affects the air quality more than we can even imagine. Particulate matter 2.5 and 10, Nitrogen dioxide, Sulfur dioxide, and carbon monoxide are key pollutants that are emitted from industries that use coal and wood as their primary energy source for production of their goods. Industrial pollution effects associated with your health can range from irritation in your eyes and throat to breathing issues, at times can even lead to chronic illness.

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3. Construction and Demolition

During clean air act movement, the Central Pollution Control Board (CPCB) registered the highest number of air pollution complaints in the Delhi NCR due to construction pollution and demolition activities. With the rise of population in the city, construction and demolition is a part of the ever going development phase of the national capital. Several construction sites and raw materials such as bricks and concrete cause haze and foul air which is hazardous for the people especially, children and elderly citizens.

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4. Use of chemical and synthetic products

Talking about air pollution, we always consider outdoor air pollution dangerous for our lives but never talk about indoor air pollution. Household products cause indoor air pollution which is 10 times more harmful than outdoor air pollution. Volatile Organic Compounds (VOCs) found in paints, cleaners and personal care products such as perfume and deodorants are a reason for common health issues. Risks like asthma or other respiratory issues and lung disease are other issues cause by inhaling poor house air quality.

4. Transportation

There is no denying that vehicle pollution is the major contributor to air pollution, especially in urban cities. When the car burns gasoline, it emits pollutants in the air which is as harmful as smoking 10 cigarettes a day. Your vehicle emits carbon monoxide, hydrocarbons, nitrogen oxide, and particulate matter. When the vehicle pollution is high in the atmosphere, it creates a hole in the ozone layer contributing to smog and causing various health issues.

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Solution 3:

Some of the effective methods to Control Air Pollution are as follows:

(a) Source Correction Methods
(b) Pollution Control equipment
(c) Diffusion of pollutant in air
(d) Vegetation
(e) Zoning.

These source correction methods are:

(i) Substitution of raw materials:
If the use of a particular raw material results in air pollution, then it should be substituted by another purer grade raw material which reduces the formation of pollutants. Thus,

(a) Low sulphur fuel which has less pollution potential can be used as an

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(b) Pollution Control Equipment:
Sometimes pollution control at source is not possible by preventing the emission of pollutants. Then it becomes necessary to install pollution control equipment to remove the gaseous pollutants from the main gas stream.

The pollutants are present in high concentration at the source and as their distance from the source increases they become diluted by diffusing with environmental air.

Pollution control equipment's are generally classified into two types:

(a) Control devices for particulate contaminants.

(b) Control devices for gaseous

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(b) Comparatively more refined liquid petroleum gas (LP G) or liquefied natural gas (LN G) can be used instead of traditional high contaminant fuels such as coal.

ii) Process Modification:
The existing process may be changed by using modified techniques to control emission at source. For example,

(a) If coal is washed before pulverization, then fly-ash emissions are considerably reduced.

(b) If air intake of boiler furnace is adjusted, then excess fly-ash emissions at power plants can be reduced.

(iii) Modification of Existing Equipment:

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Control Devices for Particulate Contaminants:

(1) Gravitational Settling Chamber:

(2) Fabric Filters (Baghouse Filters):

In a fabric filter system, a stream of the polluted gas is made to pass through a fabric that filters out the particulate pollutant and allows the clear gas to pass through. The particulate matter is left in the form of a thin dust mat on the insides of the bag. This dust mat acts as a filtering medium for further removal of particulates increasing the efficiency of the filter bag to sieve more sub micron particles $(0.5 \ \mu m)$.

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(a) For example, smoke, carbon-monoxide and fumes can be reduced if open hearth furnaces are replaced with controlled basic oxygen furnaces or electric furnaces.

(b) In petroleum refineries, loss of hydrocarbon vapours from storage tanks due to evaporation, temperature changes or displacement during filling etc. can be reduced by designing the storage tanks with floating roof covers.

(c) Pressurising the storage tanks in the above case can also give similar results.

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(d) Vegetation:

Plants contribute towards controlling air-pollution by utilizing carbon dioxide and releasing Oxygen in the process of photosynthesis. This purifies the air (removal of gaseous pollutant——CO_2) for the respiration of men and animals.

Gaseous pollutants like carbon monoxide are fixed by some plants, namely, Coleus Blumeri, Ficus variegata and Phascolus Vulgaris. Species of Pinus, Quercus, Pyrus, Juniperus and Vitis depollute the air by metabolising nitrogen oxides. Plenty of trees should be planted especially around those areas which are declared as high-risk areas of pollution.

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(2) Cyclone Separators (Reverse flow Cyclone):

Instead of gravitational force, centrifugal force is utilized by cyclone separators, to separate the particulate matter from the polluted gas. Centrifugal force, several times greater than gravitational force, can be generated by a spinning gas stream and this quality makes cyclone separators more effective in removing much smaller particulates than can possibly be removed by gravitational settling chambers.

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(5) Wet Collectors (Scrubbers):

In wet collectors or scrubbers, the particulate contaminants are removed from the polluted gas stream by incorporating the particulates into liquid droplets.

(i) Spray Tower:

Water is introduced into a spray tower by means of a spray nozzle (i.e. there is downward flow of water). As the polluted gas flows upwards, the particulates (size exceeding 10 μm) present collide with the water droplets being sprayed downward from the spray nozzles.

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(c) Diffusion of Pollutants in Air:

Dilution of the contaminants in the
atmosphere is another approach to the
control of air pollution. If the pollution
source releases only a small quantity of
the contaminants then pollution is not
noticeable as these pollutants easily
diffuse into the atmosphere but if the
quantity of air contaminants is beyond the
limited capacity of the environment to
absorb the contaminants then pollution is
caused.

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(e) Zoning:

This method of controlling air pollution can be adopted at the planning stages of the city. Zoning advocates setting aside of separate areas for industries so that they are far removed from the residential areas. The heavy industries should not be located too close to each other.

New industries, as far as possible, should be established away from larger cities (this will also keep a check on increasing concentration of urban population in a few larger cities only) and the locational decisions of large industries should be guided by regional planning. The industrial estate of Bangalore is divided into three zones namely light, medium and large industries. In Bangalore and Delhi very large industries are not permitted.

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What is a Primary Pollutant?

A primary pollutant is an air pollutant emitted from a source directly into the atmosphere. The source can be either a natural process such as sandstorms and volcanic eruptions or anthropogenic (influenced by humans) such as industrial and vehicle emissions.

Examples of primary pollutants are sulfure dioxide (SO_2), carbon monoxide (CO), nitrogen oxides (NOX), and particulate matter (PM).

Sulfur dioxide (SO_2)

Sulfur dioxide is an invisible gas with a strong odor. Its main sources are anthropogenic, resulting from the combustion of fuels and the processing of mineral ores containing sulfur. Humans and animals exposed to sulfur dioxide display

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Solution 4 :

distinguish between primary and secondary air pollutants

Air pollution is defined as the contamination of the atmosphere by substances present at concentrations above their natural levels and capable of producing adverse effects to humans, other living organisms, and the ecosystem in general.

These substances or air pollutants include gases, liquid droplets, and solid particles. They are classified according to the source of emission into two main groups: primary and secondary pollutants.

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Particulate matter (PM)

Particulate matter is a term referring to solid particles and liquid droplets found in the atmospheric air. Primary particles may be natural, originating from soil dust and sea spray. They can be industrial and transportation-related as well when their sources are metallurgical processes or exhausts and tire breaks.

What is a Secondary Pollutant?

A secondary pollutant is an air pollutant formed in the atmosphere as a result of the chemical or the physical interactions between the primary pollutants themselves or between the primary pollutants and other atmospheric components. Major examples of secondary pollutants are photochemical oxidants and secondary particulate matter.

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Photochemical oxidants

Photochemical oxidants result from the photochemical reactions involving sunlight with nitrogen oxides, sulfur dioxide, or volatile organic compounds. They include acids, nitrogen dioxide, sulfur trioxide, and ozone. Ozone is considered a highly dangerous air pollutant. Exposure to ozone can cause many lung diseases such as asthma, emphysema, and bronchitis. Repeated and long exposures to ozone may even permanently scar the lung tissue.

Secondary particulate matter

Secondary particles are the result of the condensation of gases, the chemical reactions involving primary particles with gases, and the coagulation of various primary particles. The main primary pollutants involved in the formation of secondary particulate matter are sulfur

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Carbon monoxide (CO)

Carbon monoxide is an odorless gas emitted by the incomplete combustion of fuel. The main sources for atmospheric carbon monoxide are gasoline or diesel-powered engines and biomass burning (forest fires and biomass fuels). Carbon monoxide is very toxic and is linked to an increased risk of heart disease. Exposure to high levels of CO may lead to unconsciousness or even death.

Nitrogen Oxides (NOX)

Fossil fuel combustion (gasoline and diesel engines) is the main source for nitrogen oxides in urban areas, while microbial activity in the soil and agricultural practices such as the use of synthetic fertilizers are its main sources in rural areas. Exposure to nitric oxides may cause an inflammation of the respiratory tracts.

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Difference between Primary Pollutants and Secondary Pollutants

Definition of primary vs. secondary pollutants

A primary pollutant is an air pollutant emitted from a source directly into the atmosphere.

A secondary pollutant is an air pollutant formed in the atmosphere as a result of the chemical or the physical interactions between the primary pollutants themselves or between the primary pollutants and other atmospheric components

Examples of primary vs. secondary pollutants

Examples of primary pollutants include sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen oxides (NOX), and particulate matter (PM).

Pollution effect

Primary pollutants are considered chemical reactants, being involved in the chemical reactions that result in the formation of secondary pollutants. Therefore, their pollution effect can either be direct like the impact of sulfur dioxide on the human respiratory system or indirect when sulfur dioxide interacts with water in the atmosphere to form acid rain, with serious consequences on the ecosystem.

On the other hand, secondary pollutants are chemical products inferring that they might be more stable and inert with a limited polluting effect. While this might be true to some extent, it is not the case of ozone where photoactivation is involved, making the chemical process highly reactive.

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Pollution control

The atmospheric concentration of primary pollutants can be controlled in a direct way through the reduction of anthropogenic emissions.

On the contrary, controlling the secondary pollutants is a much more complicated process: the chemical reactions involved in their formation must be understood and interrupted.

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There are four sources of air pollution :
stationary and area sources;
mobile sources;
agricultural sources;
and natural sources.

Stationary and area sources

Stationary and area sources are "point sources" of air pollution: they have a fixed location and do not move. Stationary sources are large, consistent sources of air pollution, like power plants or chemical or manufacturing facilities. Area sources are smaller sources of air pollution that are often clustered near each other, like dry cleaners or gas stations.

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Solution 4. B

A stationary source in air quality terminology is any fixed emitter of air pollutants, such as fossil fuel burning power plants, petroleum refineries, petrochemical plants, food processing plants and other heavy industrial sources.

A mobile source in air quality terminology is a non-stationary source of air pollutants, such as automobiles, buses, trucks, ships, trains, aircraft and various other vehicles.

mobile sources — such as cars, buses, planes, trucks, and trains
stationary sources — such as power plants, oil refineries, industrial facilities, and factories

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Mobile sources

Mobile sources of air pollution move. Collectively, these sources——which include cars, trucks and off-road vehicles; boats; airplanes; gas-powered lawn tools; and farm and construction equipment——can produce a significant amount of air pollution.

Agricultural sources

Agricultural sources of air pollution include those farm operations that emit gases, chemicals or particulate matter into the air. Livestock and poultry operations, for instance, often produce ammonia, which is released into the air from animal manure.

Natural sources

Natural sources of air pollution are those not caused by human activities. These include lightning, dust storms, forest fires and erupting volcanoes.

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In (4) Area Sources we have

(a) Motor Vehicle
(b) Light Delay medium delay , heavy delay
(c) Port Vessels
(d) Air Craft (Air Ports)
(e) Miscellaneous

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In (1) Point Sources we have

(a) Industrial Processing
(b) Power Plants
(c) Fuel Combustion (indutrial) coal air gas
(d) Solid waste disposed mancipal incinerators
Open burning
(e) Miscellaneous

In (2) Area Sources We have
(a) Residential heating , coal , gas, oil
(b) Institutional and commercial heating coal
Oil and gas

In (3) Line Sources we have

(a) Highway vehicles
(b) Rail road locomotives
(c) channel vessels

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Below is the details of emission inventory sources classification

Total Sources

(1) Stationary Sources
(i) Point Sources
(ii) Area Sources

(2) Mobile Sources
(i) Line Sources
(ii) Area Sources